

Confirmation of the tumour motion extraction method*

R.Brevet¹, C.Graeff¹, C.Bert² and M. Durante^{1,3}

¹GSI, Darmstadt, Germany; ²Universitätsklinikum, Erlangen, Germany; ³Technical University Darmstadt, Darmstadt, Germany

Introduction

Radiotherapy treatment of tumours located in the thorax or in the abdomen has to take into account a motion which can be caused by breathing or heart pulsation. [1] During scanned beam ion therapy, this intra-fractional motion can be responsible of dose delivery on organs at risk (OAR) and underdosage on the tumour. Several motion compensation techniques exist, such as the association of internal monitoring and external surrogates.

The motion of the tumour must be extracted from patient imaging datasets and correlated to the extern signals so that extern surrogates only can then be used to avoid additional imaging dose to the patient. Motions were extracted from MegaVoltage (MV) fluoroscopy sequences [2], but had to be confirmed as the real motions and positions of the tumours.

Algorithm validity

To find out if the obtained motions correspond to the real tumour trajectories and to confirm the validity of the algorithm, several comparisons with 4DCT datasets of the corresponding patients were investigated.

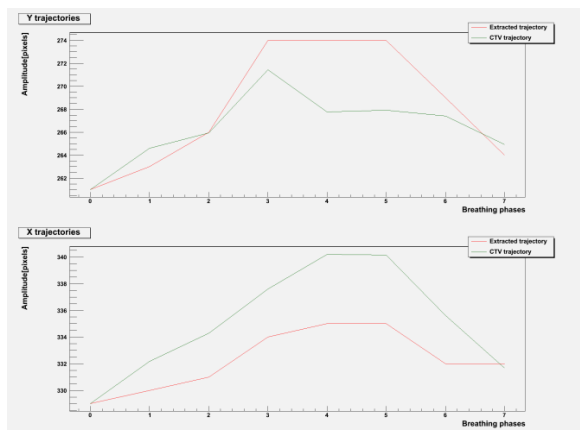


Figure 1: Comparison of trajectories obtained with the clinical target volumes (CTV) of the 8 phases of the 4DCT datasets (green) and as a result of the tracking algorithm applied on the 4DCT datasets (red)

A first example is displayed on Figure 1. The algorithm was here applied on the 4DCT datasets in order to evaluate its ability to yield a motion from this kind of imaging data.

* RB is funded as an ESR within the EU-FP-7 ENTREVISION framework, Grant Agreement no. 264552. Further funds received by DFG KFO 214.

Extracted motion confirmation

Figure 2 shows another type of comparison, which here aims at looking at the behaviours of extracted trajectories from MV-fluoroscopy sequences and CTV-based trajectories from 4DCT datasets.

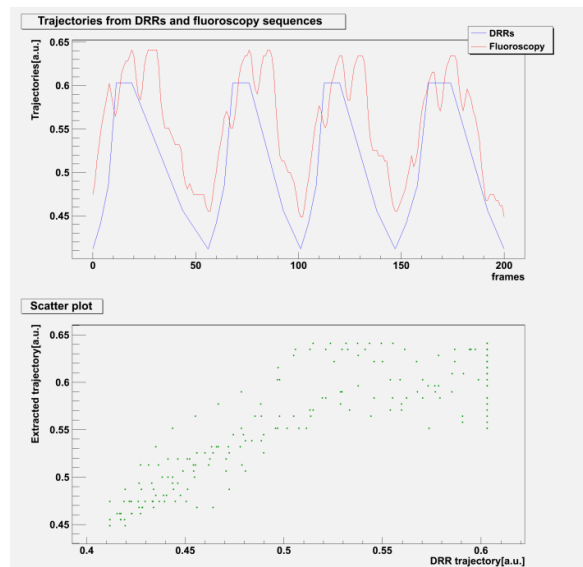


Figure 2: (top graph) Comparison of trajectories obtained with digitally reconstructed radiographs (DRR, blue) and with the motion extraction algorithm (red), (bottom graph) scatter plot used to compare the behaviours of both trajectories with each other.

For all five lung tumour patients, different parameters, such as different starting points or different DRR settings, had to be used to achieve a correlation of $r > 0.75$ and to obtain good contrast on DRRs.

Conclusion

Comparison to traces extracted from 4DCT data turned out to be strongly depending on the patient. Thus more data are needed to make conclusions.

References

- [1] C. Bert and M. Durante, 2011 Phys. Med. Biol. 56, R113-R144.
- [2] R. Brevet et al, "Analysis of internal/external motion correlation", 2012 GSI Scientific Report